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NASA TECH BRIEF

Langley Research Center

Method for Predicting Rotor Free-Wake Positions and the Resulting Rotor Blade Airloads

The problem:

Accurate predictions of rotor free-wake positions and the resulting rotor blade airloads require time-consuming and tedious calculations.

The solution:

A computer program has been designed and written to eliminate this problem.

How it's done:

Rotor-wake geometries are predicted by a process similar to that used for startup of a rotor in a free stream. An array of discrete trailing-and-shed vortices is generated, with vortex strengths corresponding to stepwise radial and azimuthal blade circulations, and is limited to an arbitrary number of azimuthal steps behind each blade. The remainder of the wake model of each blade is an arbitrary number of trailing vortices. Vortex element end points are allowed to be transported by the resultant velocity of the free-stream and vortex-induced velocities. Wake geometry, wake flow, and wake-induced velocity-influence coefficients are generated by this program for use in the blade-loads portion of the calculations.

Blade-loads computations include the effects of nonuniform inflow due to free wake, nonlinear airfoil characteristics, and response of flexible blades to applied loads. Computed wake flows and blade loads are compared with experimentally measured data. Predicted blade loads, response, and shears and moments are obtained for a model rotor system having two independent rotors. The effects of advance ratio, vertical separation of rotors, different blade-radius ratios, and different azimuthal spacing of the blades of one rotor with respect to the other, are investigated.

Notes:

1. This program is written in FORTRAN IV for use on an IBM-360 computer.
2. Requests for further information may be directed to:
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